TS 876

(19) JAPANESE PATENT OFFICE

PATENT ABSTRACTS OF JAPAN

(11) Publication number: **09030432 A**

(43) Date of publication of application: **04 . 02 . 97**

(51) Int. Cl **B62D 5/04**

(21) Application number: **07184341**

(22) Date of filing: **20 . 07 . 95**

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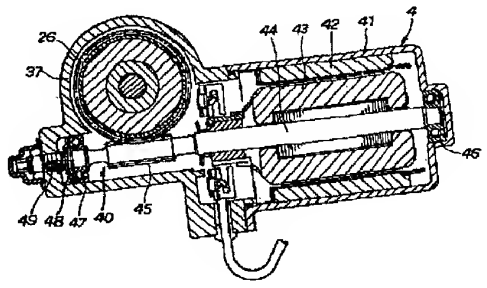
(54) MOTOR DRIVEN POWER STEERING DEVICE

(57) Abstract:

PROBLEM TO BE SOLVED: To improve a steering feeling by integrally forming the shaft of a motor and the worm shaft of a worm gear mechanism to be an output shaft and supporting both ends of this output shaft so as to be rotated.

SOLUTION: A torque transmitting means 40 for transmitting auxiliary torque generated by a motor 4 to a steering system is composed of a housing 37, a worm 45 and a wheel 26. The output shaft 44 of the motor 4 is a long shaft being extended into the housing 37 and the worm 45 is integrally formed in this shaft. That is, the output shaft 44 is one wherein the shaft of the motor 4 and the worm shaft of the torque transmitting means (worm gear mechanism) 40 are integrally formed. Thus, since no gaps are generated because it not necessary to fit in and connect the worm shaft of the worm gear mechanism 40 to the shaft of the motor 4 and unnecessary play in the rotation of a steering wheel caused by such gaps is eliminated, a steering feeling is improved.



DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] this invention relates to enhancement of electric power-steering equipment.
[0002]
[Description of the Prior Art] In order to mitigate the control force of a steering handle and to give the comfortable feeling of steering in recent years, electric power-steering equipment has been used abundantly. This kind of electric power-steering equipment generates the supplementary-with motor torque according to steering torque, transmits this supplementary torque to a steering system through a worm-gearing style and a friction engagement means of communication, and has the technique of JP,60-188064,U "the lock cancel equipment of a motorised type steering system."
[0003] According to drawing [of the official report] 1 , - view 3 , this technique is an electrical motor 21 (the number quoted what was indicated by the official report.). It is below the same. The warm shaft 27 of a worm-gearing style is fitted in at the nose of cam of an output shaft, a worm gearing 22 is connected with this warm shaft 27 through a freewheel clutch, a worm gear 23 is engaged to this worm gearing 22, and a pinion shaft 24 is connected with this worm gear 23.
[0004]
[Problem(s) to be Solved by the Invention] However, since it is the configuration which fitted in the warm shaft 27 at the nose of cam of the output shaft of an electrical motor 21, an opening occurs inevitably in fitting of both shafts and excessive play appears in rotation of a steering handle by this opening, a steering feeling becomes bad. Moreover, since the ends of the warm shaft 27 are supported, the distance between bearing is short, and for this reason, the warm shaft 27 seldom bends. There is a possibility that **** may become large since there are few amounts of bending of the warm shaft 27 when a worm gear 23 carries out thermal expansion and presses a worm gearing 22, and a steering feeling may become [frictional resistance] large bad. Furthermore, in order to support the ends of an output shaft, and the ends of the warm shaft 27, four bearing is needed, and the quantity of bearing increases. For this reason, it is not easy for the number of erectors of a motor and a worm-gearing style to be applied, and to raise a productivity, and it seldom aims at a cost cut.
[0005] The purpose of this invention is shown in aiming at a cost cut while it reduces the quantity of the bearing of offering the electric power-steering equipment which improved, ** motor, and a worm-gearing style and raises the productivity of a motor and a worm-gearing style.
[0006]
[Means for Solving the Problem] In order to attain the above-mentioned purpose, invention according to claim 1 generates the supplementary-with motor torque according to steering torque, in the electric power-steering equipment which transmits this supplementary torque to a steering system through a worm-gearing style, forms the shaft of the aforementioned motor, and the worm shaft of the aforementioned worm-gearing style in one, and considers as an output shaft, and it is characterized by supporting the both ends of this output shaft possible [rotation].
[0007] For this reason, like the conventional technique, on the shaft of a motor, since it is not necessary to carry out the fitting link of the worm shaft of a worm-gearing style, an opening does not occur, but the excessive play of invention according to claim 1 is lost to rotation of the steering handle by this opening, and a steering feeling becomes high. Moreover, since the distance between bearing is long, an output shaft tends to bend rather than the conventional technique. For this reason, since an output shaft bends when a wheel carries out thermal expansion and presses a worm, **** does not become excessive, but frictional resistance can be mitigated, and a steering feeling increases. Furthermore, since the quantity of bearing can be decreased to two pieces, the number of parts decreases, since the number of erectors of a motor and a worm-gearing style becomes fewer, a productivity improves, and it becomes easy to aim at a cost cut. Furthermore, since it is the configuration which supports the output shaft equipped with Rota of a motor, and the worm only by two points of both ends again, the attachment precision of an output shaft is high and ****** also becomes good.
[0008]
[Embodiments of the Invention] The example of this invention is explained below based on an accompanying drawying. In addition, a drawing shall be seen to the sense of a sign. First, the 1st example is explained based on drawing 1 - view 4 .
Drawing 1 is the whole electric power-steering equipment block diagram concerning this invention. the electric power-steering equipment 1 A steering torque detection means 3 to detect the steering torque of the steering system generated by the steering handle 2, The motor 4 which adds supplementary torque to a steering system, and the control unit 5 for controlling a motor 4, It has the friction engagement means of communication 30 and the torque means of communication 40

which transmit the supplementary torque which the aforementioned motor 4 generates to a steering system, and wheels 8 and 8 are ****ed through a pinion 6 and the rack 7.

[0009] Drawing 2 is an important section enlarged view of the electric power-steering equipment (the 1st example) concerning this invention, and the upper part fits into the spline 14 of the lower part of the input shaft 11 rotated by the aforementioned steering handle 2, the torsion bar spring 13 which was combined with this input shaft 11 through the pin 12, and was installed below, and this torsion bar spring 13, and it constitutes a main steering system from an output shaft 15 by which the aforementioned pinion 6 was engraved on the lower part. the member to whom angle of torsion generates a torsion bar spring 13 correctly to torque literally -- it is -- relative torsion between an input shaft 11 and the output shaft 15 -- a variation rate is generated

[0010] The steering torque detection means 3 shown in drawing 1 consists of a torsion bar spring 13, a slider 23, and a variable-inductance formula sensor 24. namely, the thing which the steering torque detection means 3 spans with the slider 23 of the shape of a cylindrical shape equipped with the inclination slot 21 and the straight slot 22 between the aforementioned input shaft 11 and the output shaft 15 -- it is -- relative torsion -- according to a variation rate, the variation rate of the slider 23 is carried out to shaft orientations The amount of displacement to the shaft orientations of a slider 23 is proportional to torque, and a sensor 24 changes the amount of displacement into an electrical signal.

[0011] Furthermore, the aforementioned friction engagement means of communication 50 fits loosely the metal wheels 26, such as phosphor bronze and cast iron, loosely into the base periphery of an output shaft 15. Friction surface 31a of the concavity of a truncated-cone form which is a cross-section abbreviation taper-like is formed in the input member 31 as which it served with this wheel 26. Moreover, the output member 32 which has friction surface 32a of the heights of a truncated-cone form which is a cross-section abbreviation taper-like possible [a shaft-orientations move] was fitted into the periphery of an output shaft 15, and it constituted from pressing this output member 32 to the aforementioned input member 31 with the compression spring 33 as a press means. The inside of drawing and 35 are housing with which a key, and 36 and 36 contain bearing and 37 contains a worm-gearing style.

[0012] Drawing 3 is a 3-3 line cross section of drawing 2 , and shows the cross-section structure of a motor 4 and a torque means of communication 40. A motor 4 consists of a metal output shaft 44 which attached a case 41, the stator 42, Rota 43, and this Rota 43. The aforementioned torque means of communication 40 transmits the supplementary torque which the motor 4 generated to a steering system, and constitutes it from a worm-gearing style which consists of the aforementioned housing 37, and a worm 45 and the wheel 26. In addition, bolt combination of the case 41 of a motor 4 is carried out at housing 37.

[0013] By the way, the output shaft 44 of a motor 4 is a long shaft prolonged in housing 37, and forms the worm 45 in this shaft at one. That is, the long output shaft 44 forms the shaft of a motor 4, and the worm shaft of a torque means of communication (worm-gearing style) 40 in one. Thus, on the shaft of a motor 4, since it is not necessary to carry out the fitting link of the worm shaft of the worm-gearing style 40, an opening does not occur, but excessive play is lost to rotation of the steering handle 2 by this opening.

[0014] Moreover, the both ends of an output shaft 44 are made into a thin path, and are supported possible [rotation] by two bearing (the 1st bearing 46 and the 2nd bearing 47). That is, an output shaft 44 is supported by the 1st bearing 46 in the back end section, and a point is supported by the 2nd bearing 47. The 2nd bearing 47 fits in possible [a shaft-orientations move into housing 37], and is pressed by the adjusting bolt 49 through flat spring 48 at the Rota 43 side. Therefore, the 1st-2nd bearing 46 and 47 can give a preload according to the press force of an adjusting bolt 49 and the flat spring 48, and it is adjusted so that there may be no end play (backlash ****). Moreover, an output shaft 44 has the thermal expansion of shaft orientations etc. absorbed by the elastic force of flat spring 48. Thus, since the 1st-2nd bearing 46 and the distance between 47 are long, an output shaft 44 tends to bend. For this reason, when a wheel 26 carries out thermal expansion in the orientation of a path and presses a worm 45, the bending rigidity of an output shaft 44 does not become excessive by the parvus's, but **** can mitigate frictional resistance.

[0015] In the electric power-steering equipment 1 which consists of the above configuration, an operation of a friction engagement means of communication 50 is explained based on drawing 4 . Drawing 4 is operation explanatory drawing of a friction engagement means of communication (the 1st example) concerning this invention. The supplementary torque of a motor 4 travels to the worm 45 formed in the output shaft 44, and rotates a wheel 26. And a rack 7 is driven through a pinion 6 with the compound torque by which the supplementary torque from a motor 4 was added to the steering torque of a steering system (input-shaft 11 -> torsion-bar-spring 13 -> output shaft 15 shown in drawing 2). That is, T2, then compound torque serve as [torque / steering / of a steering system] "T1+T2" in T1 and the supplementary torque from a motor 4. On the other hand, to the torque more than predetermined, between friction surface 31a and friction surface 32a slips, and excessive torque is not transmitted.

[0016] Next, the 2nd example is explained based on drawing 5 - view 9 . In addition, the same sign is attached about the same configuration as the 1st above-mentioned example, and the explanation is omitted. Drawing 5 is an important section expanded sectional view of the electric power-steering equipment (the 2nd example) concerning this invention, and the configuration of the 2nd example is characterized by a friction engagement means of communication 50 consisting of a friction engagement formula clutch device. The annular input member 52 is fixed to the inner circumference section of a wheel 26, and, on the other hand, the tubed output member 53 is being fixed to the periphery section of an output shaft 15. The input member 52 fits loosely into the periphery section of the output member 53 through bearing 54.

[0017] Drawing 6 is a 6-6 line cross section of drawing 5 , and shows the configuration which combined a torque means of communication 40 and a friction engagement means of communication 50. The torque means of communication 40 of this

example makes arrangement of a wheel 26 to the center of a worm 45 the 1st example and opposite side which are shown in the above-mentioned view 3 . and the center top of a wheel 26 -- and a friction engagement means of communication 50 is arranged on the same field as a wheel 26

[0018] Drawing 7 is an expanded sectional view of a friction engagement means of communication (the 2nd example) concerning this invention, and expands and shows the friction engagement means of communication 50 shown in the above-mentioned view 6 . The friction engagement means of communication 50 is 6 sets of friction engagement formula clutch devices 51 arranged on the same circle. -- (-- shows a plurality.) below the same **** -- it becomes In addition, in distinguishing each clutch device 51 -- mutually and explaining it, it explains like the clutch devices 51A, 51B, ..., 51F for convenience.

[0019] These clutch device 51 -- consists of taper-like space section 55 -- formed between the input member 52, the output member 53, these inputs / output member 52, and 53, engagement member 56-- by which it was placed between these taper-like space section 55 --, positional-controller member 58-- of this engagement member 56 -- to position, and compression spring 59-- which energizes engagement member 56 -- toward this positional-controller member 58 --. And a friction engagement means of communication 50 is a thing of positional-controller member 58 -- which switches the input member 52 and the output member 53 to engagement and being un-engaged alternatively by engagement member 56 -- in connection with a move.

[0020] If it explains in full detail, between the internal surface of the input member 52 which presents a cylinder cross section, and the three sides of the output member 53 which presents in general a conclusion form cross section (configuration which made circular the three sides of an abbreviation equilateral-triangle cross section), taper [of a total of three pairs]-like space section 55 -- will be formed by one pair of right and left for every side, and, as for these taper-like space section 55 --, a hoop-direction edge will be formed in the shape of a taper. Circular cylinder-like engagement member 56 -- is arranged possible [a move] at the one hoop-direction edge at each taper-like space section 55 -- of each, and compression spring 59 intervenes between two engagement members 56 which counter mutually, and 56.

[0021] It is the taper-like space section 55 which three positional-controllers member 58 -- intervenes possible [rotation] between the internal surface of the input member 52, and the crowning of the output member 53, and each positional-controller member 58 -- adjoins. -- It projects inside and is contacted with engagement member 56 --. Thus, it is arranged on the same circle, estranging three positional-controllers member 58 -- at equal intervals mutually.

[0022] thus, the constituted friction engagement means of communication 50 -- the -- 1 and the 3rd-5th clutch devices 51A, 51C, and 51E -- the orientation (the orientation of a counterclockwise rotation of this drawing) of arrow head X of the input member 52 -- being engaged -- the -- 2 and the 4th-6th clutch devices 51B, 51D, and 51F are engaged in arrow head X and the opposite orientation

[0023] Drawing 8 is an important section decomposition perspective diagram of a friction engagement means of communication (the 2nd example) concerning this invention, the input shaft 11 is fixing the annular positional-controller section 57 to a soffit periphery, and this positional-controller section 57 equips the lower part with aforementioned three positional-controllers member 58 --.

[0024] Next, an operation of the friction engagement means of communication of the above-mentioned configuration is explained based on the drawing 7 and the drawing 9 . Drawing 9 is an operation view of a friction engagement means of communication (the 2nd example) at this invention. When the steering handle 2 is not steered, as shown in drawing 7 , each clutch device 51 -- of all is canceled.

[0025] The phase between the output members 53 hardly changes [the steering torque of a steering handle 2] with each positional-controller member 58 -- of an input shaft 11 a parvus case. In this case, although each positional-controller member 58 -- moves in the orientation of a counterclockwise rotation of this drawing a little, each clutch device 51 -- does not have ** et al. in being engaged. For this reason, the output member 53 does not receive the supplementary torque from a motor 4, but the control force which acts on an input shaft 11 is transmitted to the output member 53 through a torsion bar spring 13.

[0026] Next, when the steering torque of a steering handle 2 is large, the phase between the output members 53 changes a lot with each positional-controller member 58 -- of an input shaft 11. In this case, as shown in drawing 9 , each positional-controller member 58 -- moves in the orientation of arrow head X greatly. the [for this reason,] -- 1 and the 3rd-5th clutch devices 51A, 51C, and 51E will be in the engagement status (Engagement member 56 -- is pushed on compression spring 59 --, moves, and is engaged in the input member 52 and the output member 53 with frictional force) .

[0027] a motor 4 rotates -- the input member 52 -- the orientation of arrow head X -- rotating -- the supplementary torque from a motor 4 -- the -- it is transmitted to the output member 53 (steering system) through 1 and the 3rd-5th clutch devices 51A, 51C, and 51E Therefore, the output member 53 is the compound torque by which the supplementary torque from a motor 4 was added to the steering torque of the steering system (input-shaft 11 -> torsion-bar-spring 13 -> output shaft 15) in drawing 5 , and is driven in the orientation of arrow head X.

[0028] On the other hand, if a steering handle 2 is steered to an opposite direction in the status that transmission of the supplementary torque by the motor 4 is continuing, it will turn around each positional-controller member 58 -- in the input member 52 and the opposite orientation (arrow head X and the opposite orientation). the [for this reason,] -- 1 and the 3rd-5th clutch devices 51A, 51C, and 51E will be in the cancel status (Engagement member 56 -- is pushed on positional-controller member 58 --, moves, and cancels the friction engagement between the input member 52 and the output member 53.)

[0029] In addition, 3 sets of clutch devices 51B, 51D, and 51F engaged in the orientation of a reverse rotation carry out 3 sets

of clutch devices 51A, 51C, and 51E and a reverse action besides the above, and when a steering handle 2 is steered in the opposite orientation, they are switched to engagement and being un-engaged.
[0030] In addition, although the 1st-2nd above-mentioned example explained the wheel 26 as metal, the effect same also as products made from a resin, such as nylon, as each example can be done so for this.
[0031]
[Effect of the Invention] this invention demonstrates the following effect by the above-mentioned configuration. The shaft of the motor for invention according to claim 1 generating the supplementary torque according to steering torque, By having formed the worm shaft of the worm-gearing style for transmitting supplementary torque to a steering system in one, having used it as the output shaft, and having supported it possible [rotation of the both ends of this output shaft] Like the conventional technique, on the shaft of a motor, since it is not necessary to carry out the fitting link of the worm shaft of a worm-gearing style, an opening does not occur, but excessive play is lost to rotation of the steering handle by this opening, and a steering feeling becomes high.
[0032] Moreover, since the distance between bearing is long, an output shaft tends to bend rather than the conventional technique. For this reason, since an output shaft bends when a wheel carries out thermal expansion and presses a worm, **** does not become excessive, but frictional resistance can be mitigated, and a steering feeling increases. Furthermore, since the quantity of bearing can be decreased to two pieces, the number of parts decreases, since the number of erectors of a motor and a worm-gearing style becomes fewer, a productivity improves, and a cost cut can be aimed at. Furthermore, since it is the configuration which supports the output shaft equipped with Rota of a motor, and the worm only by two points of both ends again, the attachment precision of an output shaft is high and ****** is also good.

[Translation done.]

MEANS

[Means for Solving the Problem] In order to attain the above-mentioned purpose, invention according to claim 1 generates the supplementary-with motor torque according to steering torque, in the electric power-steering equipment which transmits this supplementary torque to a steering system through a worm-gearing style, forms the shaft of the aforementioned motor, and the worm shaft of the aforementioned worm-gearing style in one, and considers as an output shaft, and it is characterized by supporting the both ends of this output shaft possible [rotation].
[0007] For this reason, like the conventional technique, on the shaft of a motor, since it is not necessary to carry out the fitting link of the worm shaft of a worm-gearing style, an opening does not occur, but the excessive play of invention according to claim 1 is lost to rotation of the steering handle by this opening, and a steering feeling becomes high. Moreover, since the distance between bearing is long, an output shaft tends to bend rather than the conventional technique. For this reason, since an output shaft bends when a wheel carries out thermal expansion and presses a worm, **** does not become excessive, but frictional resistance can be mitigated, and a steering feeling increases. Furthermore, since the quantity of bearing can be decreased to two pieces, the number of parts decreases, since the number of erectors of a motor and a worm-gearing style becomes fewer, a productivity improves, and it becomes easy to aim at a cost cut. Furthermore, since it is the configuration which supports the output shaft equipped with Rota of a motor, and the worm only by two points of both ends again, the attachment precision of an output shaft is high and ****** also becomes good.
[0008]
[Embodiments of the Invention] The example of this invention is explained below based on an accompanying drawying. In addition, a drawing shall be seen to the sense of a sign. First, the 1st example is explained based on drawing 1 - view 4 .
Drawing 1 is the whole electric power-steering equipment block diagram concerning this invention. the electric power-steering equipment 1 A steering torque detection means 3 to detect the steering torque of the steering system generated by the steering handle 2, The motor 4 which adds supplementary torque to a steering system, and the control unit 5 for controlling a motor 4, It has the friction engagement means of communication 30 and the torque means of communication 40 which transmit the supplementary torque which the aforementioned motor 4 generates to a steering system, and wheels 8 and 8 are ****ed through a pinion 6 and the rack 7.
[0009] Drawing 2 is the electric power-steering equipment concerning this invention.

[Translation done.]

PRIOR ART

[Description of the Prior Art] In order to mitigate the control force of a steering handle and to give the comfortable feeling of steering in recent years, electric power-steering equipment has been used abundantly. This kind of electric power-steering equipment generates the supplementary-with motor torque according to steering torque, transmits this supplementary torque to a steering system through a worm-gearing style and a friction engagement means of communication, and has the technique of JP,60-188064,U "the lock cancel equipment of a motorised type steering system."
[0003] According to drawing [of the official report] 1 , - view 3 , this technique is an electrical motor 21 (the number quoted what was indicated by the official report.). It is below the same. The warm shaft 27 of a worm-gearing style is fitted in at the nose of cam of an output shaft, a worm gearing 22 is connected with this warm shaft 27 through a freewheel clutch, a worm gear 23 is engaged to this worm gearing 22, and a pinion shaft 24 is connected with this worm gear 23.

[Translation done.]

(19)日本国特許庁（ＪＰ）　(12)**公開特許公報（Ａ）**　(11)特許出願公開番号

特開平9－30432

(43)公開日　平成９年(1997)２月４日

(51)Int.Cl.[6]	識別記号	庁内整理番号	ＦＩ	技術表示箇所
Ｂ６２Ｄ　5/04			Ｂ６２Ｄ　5/04	

審査請求　未請求　請求項の数１　ＯＬ　（全７頁）

(21)出願番号　特願平7－184341

(22)出願日　平成７年(1995)７月20日

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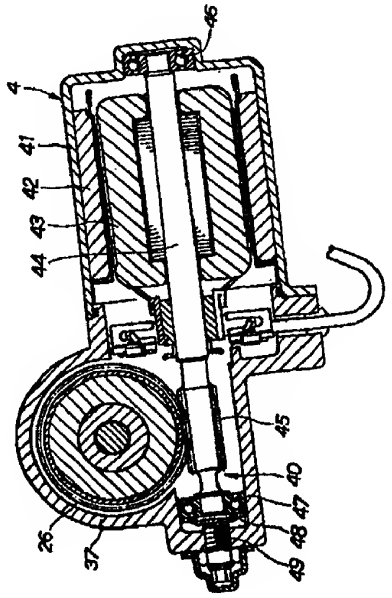
(54)【発明の名称】　電動パワーステアリング装置

(57)【要約】

【解決手段】　電動機４で操舵トルクに応じた補助トルクを発生し、この補助トルクをウォームギヤ機構４０を介してステアリング系に伝達する電動パワーステアリング装置において、電動機の軸とウォームギヤ機構のウォーム軸とを一体に形成して出力軸４４とし、この出力軸の両端部を回転可能に支持したことを特徴とする電動パワーステアリング装置。

【効果】　従来技術のように電動機の軸にウォームギヤ機構のウォーム軸を嵌合連結する必要がないので隙間が発生せず、この隙間によるステアリングハンドルの回転に余分な遊びがなくなり、操舵フィーリングが高くなる。



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【特許請求の範囲】

【請求項１】　電動機で操舵トルクに応じた補助トルクを発生し、この補助トルクをウォームギヤ機構を介してステアリング系に伝達する電動パワーステアリング装置において、前記電動機の軸と前記ウォームギヤ機構のウォーム軸とを一体に形成して出力軸とし、この出力軸の両端部を回転可能に支持したことを特徴とする電動パワーステアリング装置。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は電動パワーステアリング装置の改良に関する。

【０００２】

【従来の技術】近年、ステアリングハンドルの操舵力を軽減して快適な操舵感を与えるために、電動パワーステアリング装置が多用されてきた。この種の電動パワーステアリング装置は、電動機で操舵トルクに応じた補助トルクを発生し、この補助トルクをウォームギヤ機構及び摩擦係合伝達手段を介してステアリング系に伝達するものであって、例えば実開昭６０－１８８０６４号「モータ駆動型ステアリング装置のロック解除装置」の技術がある。

【０００３】この技術は、その公報の図１～図３によれば、電動モータ２１（番号は公報に記載されたものを引用した。以下同じ。）の出力軸の先端にウォームギヤ機構のウォームシャフト２７を嵌合し、このウォームシャフト２７にフリーホイールクラッチを介してウォームギヤ２２を連結し、このウォームギヤ２２にウォームホイール２３を噛み合わせ、このウォームホイール２３にピニオンシャフト２４を連結したものである。

【０００４】

【発明が解決しようとする課題】しかし、電動モータ２１の出力軸の先端にウォームシャフト２７を嵌合した構成であり、両軸同士の嵌合には必然的に隙間が発生し、この隙間によってステアリングハンドルの回転に余分な遊びがでるので、操舵フィーリングは悪くなる。また、ウォームシャフト２７の両端を支持するので軸受間距離が短く、このため、ウォームシャフト２７は撓みにくい。ウォームホイール２３が熱膨張してウォームギヤ２２を押圧した際に、ウォームシャフト２７の撓み量が少ないので歯圧が大きくなり、摩擦抵抗が大きく操舵フィーリングが悪くなる恐れがある。更に、出力軸の両端とウォームシャフト２７の両端とを支持するために４個の軸受を必要とし、軸受の数量が多くなる。このため、電動機とウォームギヤ機構の組立工数がかかり生産性を高めることが容易でなく、また、コストダウンを図りにくい。

【０００５】本発明の目的は、①操舵フィーリングの向

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て、電動機とウォームギヤ機構の生産性を高めるとともに、コストダウンを図ることにある。

【０００６】

【課題を解決するための手段】上記目的を達成するために、請求項１記載の発明は、電動機で操舵トルクに応じた補助トルクを発生し、この補助トルクをウォームギヤ機構を介してステアリング系に伝達する電動パワーステアリング装置において、前記電動機の軸と前記ウォームギヤ機構のウォーム軸とを一体に形成して出力軸とし、この出力軸の両端部を回転可能に支持したことを特徴とする。

【０００７】このため、請求項１記載の発明は、従来技術のように電動機の軸にウォームギヤ機構のウォーム軸を嵌合連結する必要がないので隙間が発生せず、この隙間によるステアリングハンドルの回転に余分な遊びがなくなり、操舵フィーリングが高くなる。また、出力軸は軸受間距離が長いので従来技術よりも撓み易い。このため、ホイールが熱膨張してウォームを押圧した際に出力軸が撓むので、歯圧が過大にならず摩擦抵抗を軽減でき、操舵フィーリングが高まる。更に、軸受の数量を２個に減少できるので部品数が少なくなり、電動機とウォームギヤ機構の組立工数が減るので生産性が向上し、また、コストダウンを図り易くなる。更にまた、電動機のロータとウォームとを備えた出力軸を両端部の２点だけで支持する構成なので、出力軸の組付け精度が高く、組付性も良くなる。

【０００８】

【発明の実施の形態】本発明の実施例を添付図面に基づいて以下に説明する。なお、図面は符号の向きに見るものとする。先ず、図１～図４に基づき第１実施例を説明する。図１は本発明に係る電動パワーステアリング装置の全体構成図であり、電動パワーステアリング装置１は、ステアリングハンドル２で発生されたステアリング系の操舵トルクを検出する操舵トルク検出手段３と、ステアリング系に補助トルクを付加する電動機４と、電動機４を制御するための制御装置５と、前記電動機４の発生する補助トルクをステアリング系に伝達する摩擦係合伝達手段３０及びトルク伝達手段４０とを有し、ピニオン６，ラック７を介して車輪８，８を転舵するものである。

【０００９】図２は本発明に係る電動パワーステアリング装置（第１実施例）の要部拡大図であり、前記ステアリングハンドル２で回動される入力軸１１と、この入力軸１１にピン１２を介して結合され下方へ延設されたトーションバー１３と、このトーションバー１３の下部のスプライン１４に上部が嵌合され、下部に前記ピニオン６が刻設された出力軸１５とで主たるステアリング系を構成したものである。トーションバー１３は文字通りトルクに対して正確にねじれ角が発生するメンバーであっ

を発生する。

【００１０】図１に示す操舵トルク検出手段３は、トーションバー１３、スライダ２３及び可変インダクタンス式センサ２４で構成する。すなわち、操舵トルク検出手段３は、傾斜溝２１とストレート溝２２とを備えた円筒形状のスライダ２３を、前記入力軸１１と出力軸１５との間に掛け渡すことで、相対ねじり変位に応じてスライダ２３を軸方向へ変位させるものである。スライダ２３の軸方向への変位量はトルクに比例し、センサ２４は変位量を電気信号に変換する。

【００１１】更に、前記摩擦係合伝達手段５０は、出力軸１５の基部外周にリン青銅や鋳鉄などの金属製ホイール２６を遊嵌し、このホイール２６と兼ねた入力部材３１に断面略テーパー状である円錐台形の凹部の摩擦面３１ａを形成し、また、出力軸１５の外周に軸方向移動可能に断面略テーパー状である円錐台形の凸部の摩擦面３２ａを有する出力部材３２を嵌合し、この出力部材３２を押圧手段としての圧縮ばね３３で前記入力部材３１に押圧することで構成した。図中、３５はキー、３６，３６は軸受、３７はウォームギヤ機構を収納するハウジングである。

【００１２】図３は図２の３－３線断面図であり、電動機４とトルク伝達手段４０の断面構造を示す。電動機４はケース４１と、ステータ４２と、ロータ４３と、このロータ４３を取付けた金属製の出力軸４４とからなる。前記トルク伝達手段４０は、電動機４の発生した補助トルクをステアリング系へ伝達するものであり、前記ハウジング３７と、ウォーム４５とホイール２６とからなるウォームギヤ機構で構成する。なお、電動機４のケース４１はハウジング３７にボルト結合されている。

【００１３】ところで、電動機４の出力軸４４はハウジング３７内に延びる長い軸であり、この軸にウォーム４５を一体に形成している。すなわち、長い出力軸４４は電動機４の軸とトルク伝達手段（ウォームギヤ機構）４０のウォーム軸とを一体に形成したものである。このように、電動機４の軸にウォームギヤ機構４０のウォーム軸を嵌合連結する必要がないので隙間が発生せず、この隙間によるステアリングハンドル２の回転に余分な遊びがなくなる。

【００１４】また、出力軸４４の両端部は細い径とされ、且つ２個の軸受（第１軸受４６と第２軸受４７）で回転可能に支持されている。すなわち、出力軸４４は後端部を第１軸受４６で支持され、先端部を第２軸受４７で支持される。第２軸受４７はハウジング３７内に軸方向移動可能に嵌合され、板ばね４８を介して調整ボルト４９でロータ４３側に押圧されている。従って第１・第２軸受４６，４７は、調整ボルト４９と板ばね４８の押圧力により予荷重を与えられて、軸方向の遊びがないように調整（どり取り）される。また出力軸４４は、板ばね４８の押圧力により予荷重を与えられて、軸方向の遊びがないように調整（どり取り）される。このように、出力軸４４は第１・第２軸受４６，４７間距離が長いので撓み易い。このため、ホイール２６が径方向に熱膨張してウォーム４５を押圧した際に出力軸４４の曲げ剛性が小さいので、歯圧が過大にならず摩擦抵抗を軽減できる。

【００１５】以上の構成からなる電動パワーステアリング装置１において、摩擦係合伝達手段５０の作用を図４に基づき説明する。図４は本発明に係る摩擦係合伝達手段（第１実施例）の作用説明図である。電動機４の補助トルクは、出力軸４４に形成されたウォーム４５に伝わり、ホイール２６を回動する。そして、ステアリング系（図２に示す入力軸１１→トーションバー１３→出力軸１５）の操舵トルクに、電動機４からの補助トルクが付加されたところの複合トルクでピニオン６を介してラック７を駆動する。すなわち、ステアリング系の操舵トルクをＴ１、電動機４からの補助トルクをＴ２とすれば、複合トルクは「Ｔ１＋Ｔ２」となる。一方、所定以上のトルクに対しては、摩擦面３１ａと摩擦面３２ａとの間がスリップし、過大トルクを伝達しない。

【００１６】次に、図５～図９に基づき第２実施例を説明する。なお、上記第１実施例と同じ構成については同一符号を付し、その説明を省略する。図５は本発明に係る電動パワーステアリング装置（第２実施例）の要部拡大断面図であり、第２実施例の構成は摩擦係合伝達手段５０が摩擦係合式クラッチ機構からなることを特徴とする。ホイール２６の内周部に環状の入力部材５２が固定され、一方、出力軸１５の外周部に筒状の出力部材５３が固定されている。出力部材５３の外周部には軸受５４を介して入力部材５２が遊嵌される。

【００１７】図６は図５の６－６線断面図であり、トルク伝達手段４０と摩擦係合伝達手段５０とを組合わせた構成を示す。この実施例のトルク伝達手段４０は、ウォーム４５の中心に対するホイール２６の配置を、上記図３に示す第１実施例と反対側としている。そして、ホイール２６の中心上に且つホイール２６と同一面上に摩擦係合伝達手段５０が配置される。

【００１８】図７は本発明に係る摩擦係合伝達手段（第２実施例）の拡大断面図であり、上記図６に示す摩擦係合伝達手段５０を拡大して示す。摩擦係合伝達手段５０は同一円上に配置された６組の摩擦係合式クラッチ機構５１…（…は複数を示す。以下同じ。）からなる。なお、各クラッチ機構５１…を互いに区別して説明する場合には、便宜的にクラッチ機構５１Ａ，５１Ｂ，……，５１Ｆのように説明する。

【００１９】これらのクラッチ機構５１…は、入力部材５２と、出力部材５３と、これら入力・出力部材５２，５３間で形成したテーパ状空間部５５…と、このテーパ状空間部５５…に介在した係合部材５６…と、この係合部材５６…の位置決めをなす位置制御部材５８…と、こ

る圧縮ばね５９…とからなる。そして、摩擦係合伝達手段５０は位置制御部材５８…の移動にともなって、係合部材５６…で入力部材５２と出力部材５３とを係合・非係合に選択的に切換えるものである。

【００２０】詳述すると、円筒断面を呈する入力部材５２の内壁面と、概ねおむすび形断面（略正三角形断面の３つの辺を円弧状とした形状）を呈する出力部材５３の３つの辺との間で、各辺毎に左右１対で計３対のテーパ状空間部５５…が形成され、これらのテーパ状空間部５５…は周方向端部がテーパ状に形成される。各テーパ状空間部５５…には円柱状の係合部材５６…が周方向端部に１つずつ移動可能に配置され、互いに対向する２つの係合部材５６，５６間に圧縮ばね５９が介在される。

【００２１】入力部材５２の内壁面と出力部材５３の頂部との間に、３つの位置制御部材５８…が回動可能に介在され、各位置制御部材５８…は隣接するテーパ状空間部５５…内に突出して係合部材５６…と当接される。このように、３つの位置制御部材５８…は、互いに等間隔で離間しつつ同一円上に配置される。

【００２２】このように構成された摩擦係合伝達手段５０は、第１・第３・第５クラッチ機構５１Ａ，５１Ｃ，５１Ｅが入力部材５２の矢印Ｘ方向（この図の反時計回り方向）に係合し、第２・第４・第６クラッチ機構５１Ｂ，５１Ｄ，５１Ｆが矢印Ｘと反対方向に係合する。

【００２３】図８は本発明に係る摩擦係合伝達手段（第２実施例）の要部分解斜視図であり、入力軸１１は下端外周に環状の位置制御部５７を固定しており、この位置制御部５７は下部に前記３つの位置制御部材５８…を備えている。

【００２４】次に上記構成の摩擦係合伝達手段の作用を図７及び図９に基づき説明する。図９は本発明に摩擦係合伝達手段（第２実施例）の作用図である。ステアリングハンドル２が操舵されていない場合、図７に示すように各クラッチ機構５１…は全て解除されている。

【００２５】ステアリングハンドル２の操舵トルクが小さい場合、入力軸１１の各位置制御部材５８…と出力部材５３との間の位相がほとんど変化しない。この場合には、各位置制御部材５８…がこの図の反時計回り方向に若干移動するものの、各クラッチ機構５１…が係合するには致らない。このため、出力部材５３は電動機４からの補助トルクを受けず、入力軸１１に作用する操舵力はトーションバー１３を介して出力部材５３へ伝達される。

【００２６】次に、ステアリングハンドル２の操舵トルクが大きい場合、入力軸１１の各位置制御部材５８…と出力部材５３との間の位相が大きく変化する。この場合には図９に示すように、各位置制御部材５８…が矢印Ｘ方向に大きく移動する。このため、第１・第３・第５クラッチ機構５１Ａ，５１Ｃ，５１Ｅは係合状態になる。

摩擦力にて入力部材５２と出力部材５３とを係合する）。

【００２７】電動機４が回転することで入力部材５２が矢印Ｘ方向に回転し、電動機４からの補助トルクは、第１・第３・第５クラッチ機構５１Ａ，５１Ｃ，５１Ｅを介して出力部材５３（ステアリング系）に伝達される。従って、出力部材５３は図５におけるステアリング系（入力軸１１→トーションバー１３→出力軸１５）の操舵トルクに、電動機４からの補助トルクが付加されたところの複合トルクで、矢印Ｘ方向に駆動される。

【００２８】一方、電動機４による補助トルクの伝達が継続している状態で、ステアリングハンドル２を逆方向に操舵すると、各位置制御部材５８…は入力部材５２と反対方向（矢印Ｘと反対方向）に回る。このため、第１・第３・第５クラッチ機構５１Ａ，５１Ｃ，５１Ｅは解除状態になる。（係合部材５６…が位置制御部材５８…に押されて移動し、入力部材５２と出力部材５３との間の摩擦係合を解除する。）

【００２９】なお、逆回転方向に係合する３組のクラッチ機構５１Ｂ，５１Ｄ，５１Ｆは、上記他の３組のクラッチ機構５１Ａ，５１Ｃ，５１Ｅと逆作動をするものであり、ステアリングハンドル２を反対方向に操舵した場合に係合・非係合に切換えられる。

【００３０】なお、上記第１・第２実施例ではホイール２６を金属製として説明したが、これをナイロン等の樹脂製としても、各実施例と同様の効果を奏することができる。

【００３１】

【発明の効果】本発明は上記構成により次の効果を発揮する。請求項１記載の発明は、操舵トルクに応じた補助トルクを発生するための電動機の軸と、補助トルクをステアリング系に伝達するためのウォームギヤ機構のウォーム軸とを、一体に形成して出力軸とし、この出力軸の両端部を回転可能に支持したことにより、従来技術のように電動機の軸にウォームギヤ機構のウォーム軸を嵌合連結する必要がないので隙間が発生せず、この隙間によるステアリングハンドルの回転に余分な遊びがなくなり、操舵フィーリングが高くなる。

【００３２】また、出力軸は軸受間距離が長いので従来技術よりも撓み易い。このため、ホイールが熱膨張してウォームを押圧した際に出力軸が撓むので、歯圧が過大にならず摩擦抵抗を軽減でき、操舵フィーリングが高まる。更に、軸受の数量を２個に減少できるので部品数が少なくなり、電動機とウォームギヤ機構の組立工数が減るので生産性が向上し、また、コストダウンを図れる。更にまた、電動機のロータとウォームとを備えた出力軸を両端部の２点だけで支持する構成なので、出力軸の組付け精度が高く、組付性も良い。

【図面の簡単な説明】

体構成図

【図2】本発明に係る電動パワーステアリング装置（第1実施例）の要部拡大図

【図3】図2の3－3線断面図

【図4】本発明に係る摩擦係合伝達手段（第1実施例）の作用説明図

【図5】本発明に係る電動パワーステアリング装置（第2実施例）の要部拡大断面図

【図6】図5の6－6線断面図

【図7】本発明に係る摩擦係合伝達手段（第2実施例）の拡大断面図

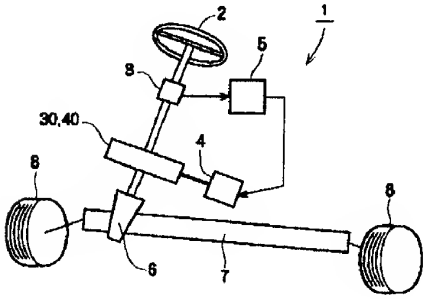
【図8】本発明に係る摩擦係合伝達手段（第2実施例）の要部分解斜視図

【図9】本発明に摩擦係合伝達手段（第2実施例）の作用図

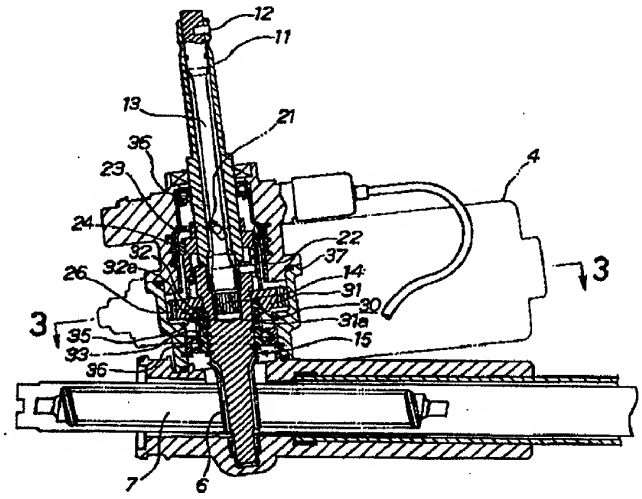
【符号の説明】

1…電動パワーステアリング装置、2…ステアリングハンドル、4…電動機、6…ピニオン、7…ラック、11…入力軸、13…トーションバー、15…出力軸、26…ホイール、30…摩擦係合伝達手段、37…ハウジング、40…トルク伝達手段（ウォームギヤ機構）、44…出力軸、45…ウォーム、46…軸受、50…摩擦係合伝達手段。

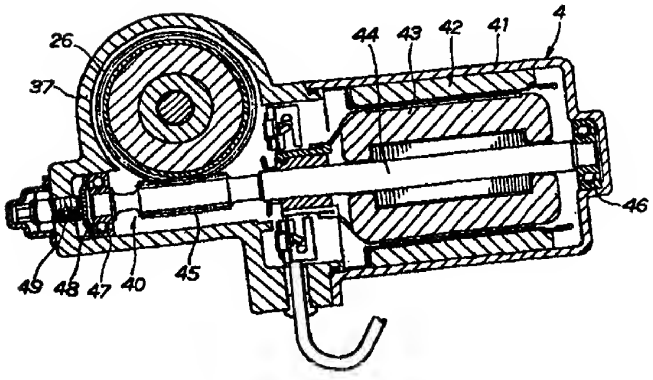
【図1】



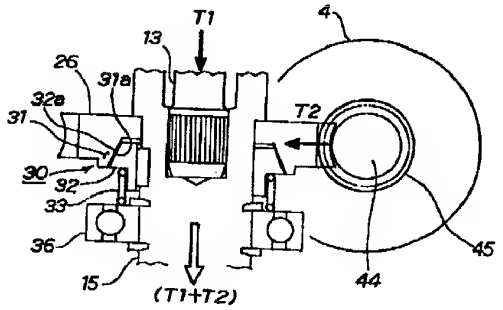
【図2】



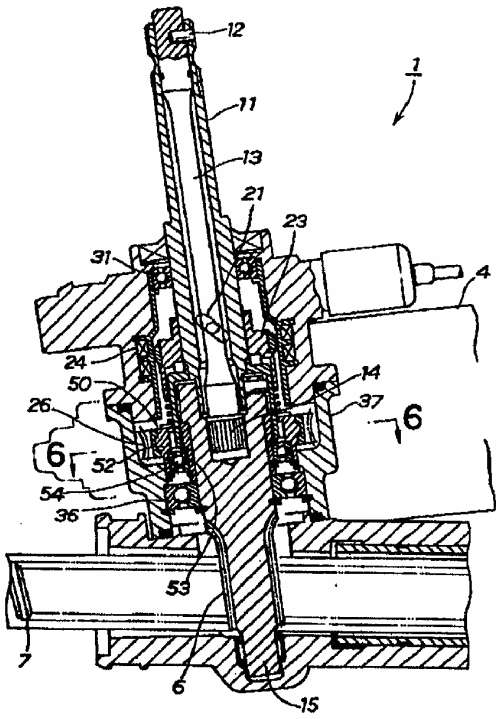
【図3】



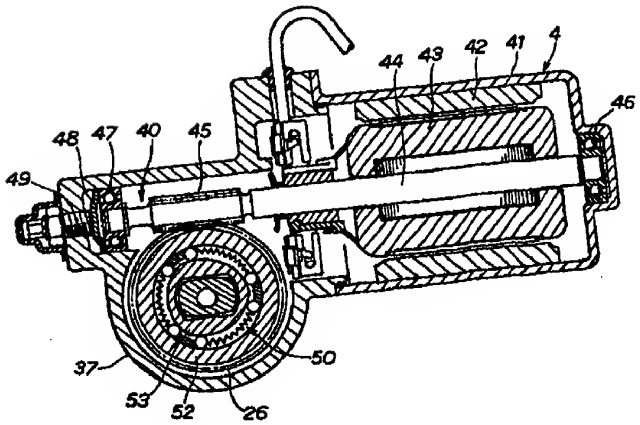
【図4】


T1
13
4
26
31a
32a
31
T2
30
32
33
36
15
(T1+T2)
44
45

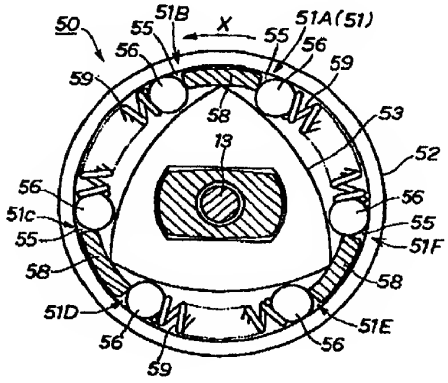
【図5】


12
1
11
13
21
23
31
4
24
14
50
37
26
6
6
52
54
36
53
7
6
15

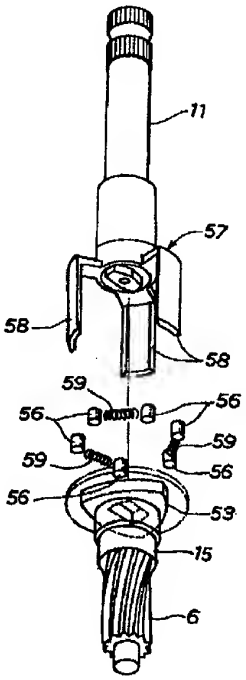
【図6】


44
43
42
41
4
46
48
47
40
45
49
37
50
53
52
26

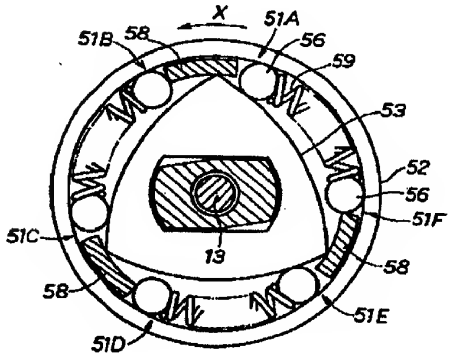
【図7】


50
51B
X
51A(51)
55
56
59
58
53
52
19
56
55
51F
51C
51D
51E

【図8】


11
57
58
59
56
53
15
6

【図9】


X
51A
51B
58
56
59
53
52
51F
51C
19
58
51E
51D